

## ***Hapalotrema dorsopora* sp. n. (Trematoda: Spirorchidae) from the Heart of the Green Turtle (*Chelonia mydas*) with a Redescription of *Hapalotrema postorchis***

MURRAY D. DAILEY,<sup>1</sup> MARTHA L. FAST,<sup>2</sup> AND GEORGE H. BALAZS<sup>3</sup>

<sup>1</sup> Ocean Studies Institute, California State University, Long Beach, California 90840,

<sup>2</sup> P.O. Box 14360, Ojai, California 93023, and

<sup>3</sup> National Marine Fisheries Service, Southwest Fisheries Science Center, Honolulu Laboratory, 2570 Dole Street, Honolulu, Hawaii 96822

**ABSTRACT:** *Hapalotrema dorsopora* sp. n. from the heart of the green turtle *Chelonia mydas* is described. *Hapalotrema dorsopora* differs from all other members of the genus by having a separate dorsal uterine pore. *Hapalotrema dorsopora* most resembles *Hapalotrema mehrai* Rao, 1976, but differs, in addition to separate dorsal and ventral pores, in placement of testes and vitellaria and shape of ovary. *Hapalotrema postorchis* Rao, 1976, originally described from a single specimen, is redescribed.

**KEY WORDS:** Trematoda, *Hapalotrema dorsopora* sp. n., Spirorchidae, green turtle, *Chelonia mydas*, Hawaii.

From 1986 to 1988, 10 green sea turtles (*Chelonia mydas* L.) were found stranded on the islands of Lanai, Maui, and Oahu in Hawaii. The turtles were covered with neoplasms identified as fibropapillomas. Upon determination that the turtles would not survive, they were killed and examined for parasites. Eight turtles, 6 from Oahu, 1 from Lanai, and 1 from Maui, were found infected with an undescribed species of the genus *Hapalotrema* Looss, 1899.

### **Materials and Methods**

Worms were placed in tapwater and refrigerated overnight, fixed in alcohol–formalin–acetic acid for 2 days, and then transferred to 70% ethyl alcohol for storage. Whole mounts were stained in Semichon's acetocarmine, dehydrated in a graded alcohol series, and mounted in Canada balsam. Specimens for scanning electron microscopy were critical-point dried using CO<sub>2</sub> as the transition fluid in a Polaron critical-point dryer and mounted on specimen stubs using conductive graphite paint (TV tube coat). Specimens were coated for 10 min at 10 mA with gold-palladium in a Technics Hummer V sputter coater and examined with an AMR 1000 at 8–20 kV. All measurements are in micrometers unless otherwise indicated and are given as a range with the mean in parentheses. Illustrations were made with the aid of a drawing tube. Voucher specimens have been deposited in the USNM Helminthological Collection.

### **Results**

Seven species of digenetic trematodes were collected from 10 specimens of green turtles in Hawaii (Table 1). Trematodes of the genus *Hapalotrema* occurred as 35% of total worms recovered and in 80% of turtles examined.

### **Description**

#### ***Hapalotrema dorsopora* sp. n.**

(Figs. 1–3, 7)

*Hapalotrema dorsopora* sp. n. Spirorchidae Stunkard, 1921. The following description based on 10 specimens.

**SPECIFIC DIAGNOSIS:** Body elongate, 9.2–10.6 mm (9.9) long, maximum width 0.59–1.1 mm (0.86) at midbody. Oral sucker terminal, 420–450 (430) long by 360–370 (368) wide. Esophagus tubular, 630–720 (680) long surrounded by large gland cells at bifurcation (at 8% of body length) anterior to acetabulum. Intestinal ceca slightly sinuous, terminating posteriorly near anterior end of Y-shaped excretory vesicle. Acetabulum larger than oral sucker, discoid, covered with minute spines, pedunculate, with folded outer margin, 583–684 (610) in diameter. Peduncle 526–631 (578) long by 390–430 (410) wide. Testes numerous, 78–177 (119) long by 52–112 (78) wide, separated into pre- (47–56) and postovarian (48–54) groups filling intercecal space. External seminal vesicle 262–396 (308) long by 90–195 (139) wide, intercecal, transverse between preovarian testes group and ovary. Cirrus sac 270–338 (297) long by 60–90 (73) wide with internal seminal vesicle, ejaculatory duct and cirrus. Male genital pore median, ventral, and sinistral to ovary. Ovary oval, submedian, with irregular margins, 577–763 (665) long by 579–736 (666) wide, between testicular groups. Seminal receptacle immediately posterior to ovary. Dorsal uterine pore, median, on raised muscular pad (Fig. 7), 21 posterior to vitelline

Table 1. Digenetic trematode parasites found infecting 10 green turtles from Hawaii.

	Locality*	USNM Coll. No.	Prevalence	Mean intensity	Range
<i>Learedius learedi</i>	1, 3	82321	40%	20.0	4–43
<i>Haplotrema dorsopora</i>	1, 2, 3	82326	80%	8.0	3–20
<i>Polyangium linguatula</i>	1, 2	82322	40%	3.5	1–9
<i>Angiodictyum longum</i>	1, 2	82323	30%	3.0	2–5
<i>Haplotrema postorchis</i>	1	82324	30%	6.0	2–14
<i>Caretta hawaiiensis</i>	1, 3	81897	30%	10.0	3–17
<i>Pyelosoma cochlear</i>	1	82327	10%	19.0	19

\* 1, Oahu; 2, Lanai; 3, Maui.

reservoir. Vitellaria mostly extracecal extending from pretesticular region to posterior extremity. Uterus short with metraterm, looping posteriorly from ovary to dorsal uterine pore. Eggs ( $N = 10$ ) elongate with single or double polar filaments, 144–196 (170) long by 20–32 (26) wide.

HOST: Green turtle, *Chelonia mydas* L.

LOCATION: Heart.

LOCALITY: Kailua Bay, Oahu, Hawaii.

HOLOTYPE: USNM Helm. Coll. No. 82326.

PARATYPE: USNM Helm. Coll. No. 82327.

ETYMOLOGY: Dorso (L) = back; pora (L) = pore.

REMARKS: The new species most resembles *H. mehrai* Rao, 1976, but differs in size (*H. dorsopora* is larger); disposition of testes (first few preovarian testes only in 2 rows in *H. mehrai*, not found in *H. dorsopora*); placement of vitellaria (begin just posterior to acetabulum in *H. mehrai*, just anterior to testes in *H. dorsopora*); ovary entire in *H. mehrai*, irregular in *H. dorsopora*; dorsal uterine pore present in *H. dorsopora*, absent in *H. mehrai*.

***Haplotrema postorchis* Rao, 1976  
(Figs. 4–6)**

Redescription based on 10 specimens. Body elongate, 10.3–12.8 mm (11.6) long, maximum width 1.0–1.8 mm (1.3). Tegument spinose; spines lost in frozen specimens. Oral sucker terminal, small, subspherical, 230–330 (250) wide by 240–360 (275) long; pharynx absent; esoph-

agus narrow, thin-walled, 810–870 (832) long; bifurcating at 6–8% (7%) body length, just anterior to acetabulum, into 2 slender ceca, which extend to posterior extremities. Acetabulum slightly pedunculate, spherical, larger than oral sucker, 420–910 (714) in diameter, perimeter of sucker spinose, anterior edge at 9–12% (10.5%) body length. Testes few, 15–18 (17) measuring 430–620 (496) long by 280–420 (372) wide, separated by ovary into pre- (7–11) and postovarian (6–9) groups. Cirrus pouch large, 710–900 (840) long by 240–310 (285) wide, with internal seminal vesicle, ejaculatory duct and cirrus. External seminal vesicle transverse, between preovarian testes and ovary, measuring 480–670 (590) long by 250–380 (310) wide. Genital pore sinistral at lower level of ovary. Ovary lobed, between third and fourth quarter of body, 710–870 (775) long by 470–680 (618) wide. Vitellaria inter- and extracecal beginning 638–1020 (842), postacetabulum. Uterus short with metraterm. Eggs ( $N = 10$ ) elongate with polar filament on each end measuring 140–330 (168)  $\times$  29–41 (32).

HOST: *Chelonia mydas* L.

LOCATION: Heart.

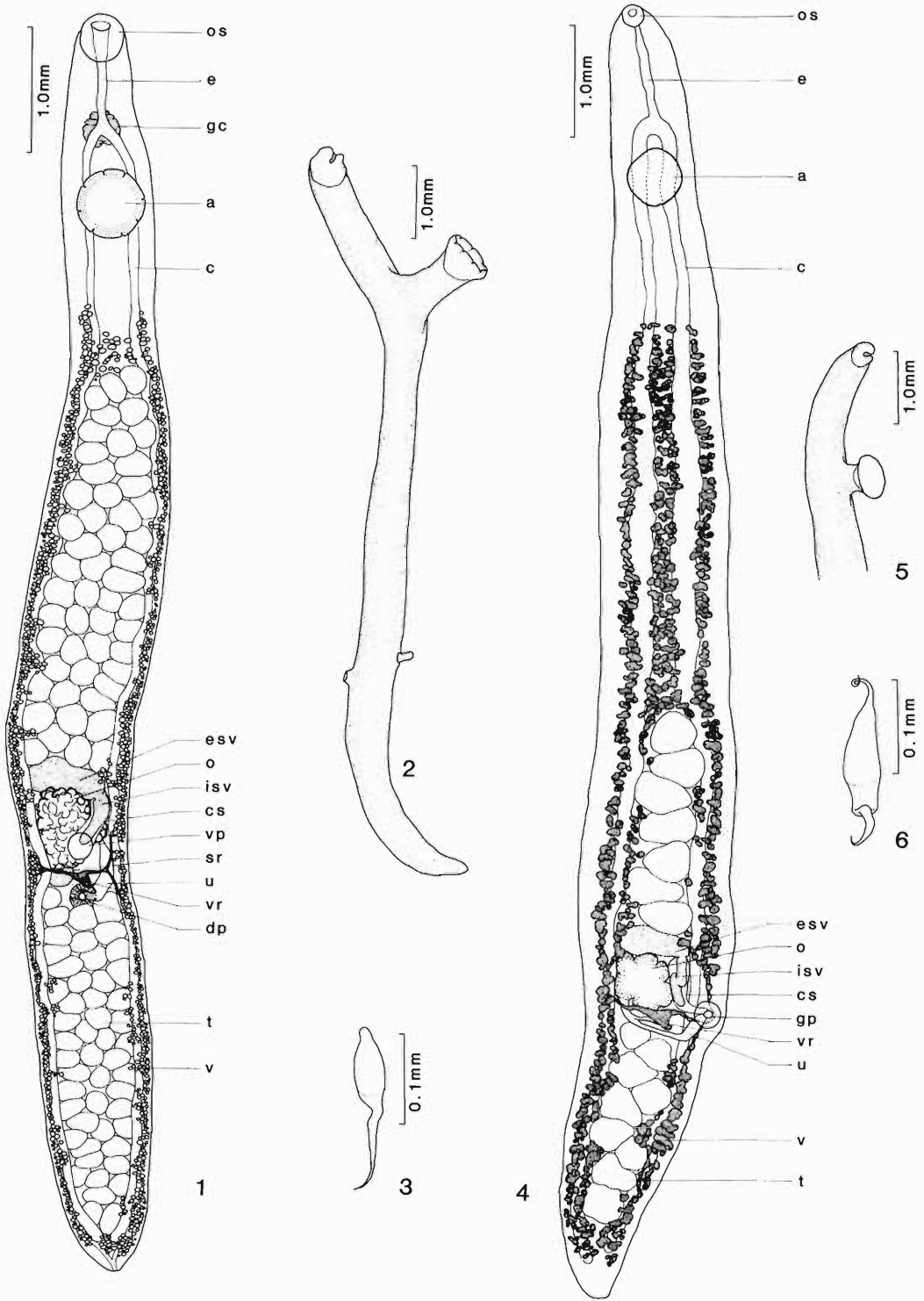
LOCALITY: Pamban, South India, Gulf of Mannar (type locality; Rao, 1976). Kaneohe Bay, Oahu, Hawaii (this study).

VOUCHER SPECIMEN: USNM Helm. Coll. No. 82324.

REMARKS: According to the original descrip-

→

Figures 1–6. 1–3. *Haplotrema dorsopora* sp. n. 1. Entire worm (ventral view). 2. Outline of entire worm (lateral view) showing pedunculate acetabulum, placement of dorsal and ventral openings. 3. Egg. 4–6. *Haplotrema postorchis* redescription. 4. Entire worm (ventral view). 5. Outline of worm anterior showing slightly pedunculate acetabulum (lateral view). 6. Egg. a, acetabulum; c, cecum; cs, cirrus sac; dp, dorsal pore; e, esophagus; esv, external seminal vesicle; gc, gland cells; isv, internal seminal vesicle; o, ovary; os, oral sucker; sr, seminal receptacle; t, testis; u, uterus; v, vitellaria; vp, ventral pore; vr, vitelline reservoir.



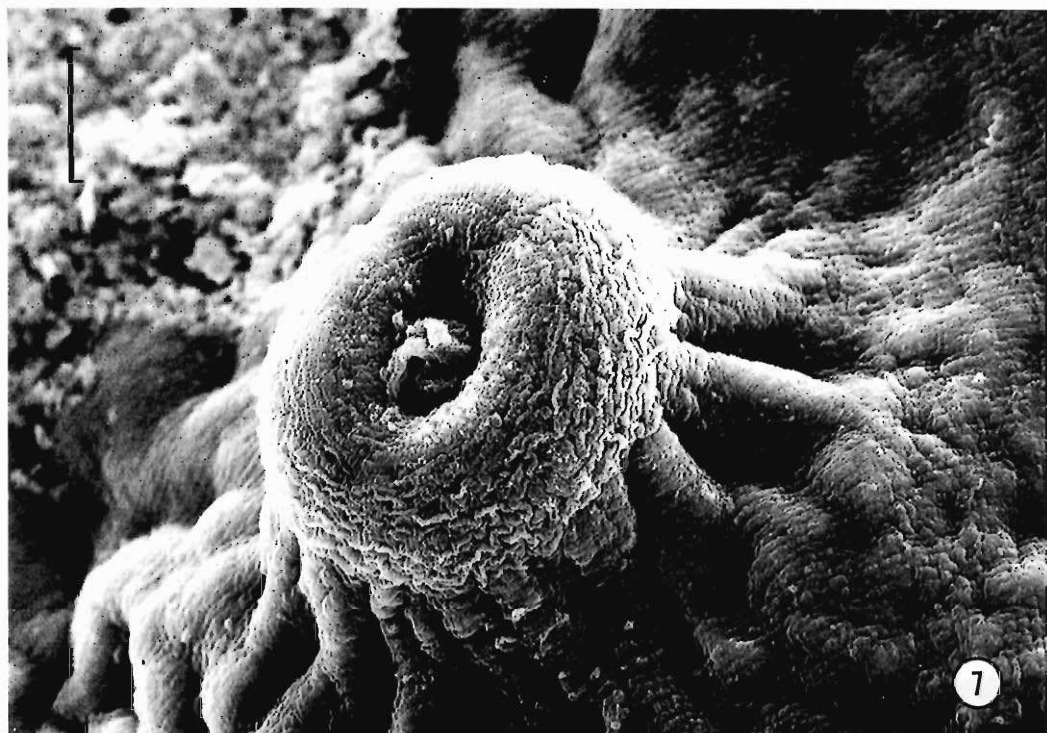


Figure 7. *Hapalotrema dorsopora* sp. n. Scanning electron micrograph of dorsal uterine pore showing large, muscular-raised base. Scale bar = 30  $\mu$ m.

tion by Rao (1976), the measurements were taken from only 1 specimen. The specimen was not deposited in any collection and all attempts to examine the type material were unsuccessful. Differences seen between worms of this study and the Rao description are as follows. The acetabulum is slightly pedunculate and ringed with fine spines in the Hawaiian specimens. The total number of testes of the worm figured in the 1976 publication is shown at 19 (9 pre- and 10 post-ovarian). In our study, the maximum number found in any specimen examined was 18. The ceca are figured by Rao as bifurcating widely enough to circumvent the acetabulum. In the Hawaiian specimens, the ceca always continued behind the ventral sucker. Also, the vitellaria placement differs between the material in this study and those of the original description (beginning more posteriad in the Hawaiian material).

#### Discussion

The blood flukes of sea turtles have been reviewed recently by Smith (1972) and Glazebrook et al. (1989). The genus *Hapalotrema* is sepa-

rated from other members of the subfamily Haplotrematinae Stunkard, 1921, by its large number of testes divided by the ovary and terminal genitalia into 2 groups (Yamaguti, 1958; Skrjabin, 1964). Smith (1972) lists 5 species of *Hapalotrema* in his review (*H. loossi* Price, 1934; *H. mistroides* (Monticelli, 1896) Stiles and Hassall, 1908; *H. orientalis* Takeuti, 1942; *H. polesianum* (Ejmont, 1927) Byrd, 1939; *H. synorchis* Luhman, 1935). Glazebrook et al. (1989) list only 3 species of *Hapalotrema* in their table "Cardiovascular flukes recovered from sea turtles (1962 to present day)." There are currently 7 recognized species of *Hapalotrema* (Smith, 1972, omitted the 2 species from India, *H. mahrai* and *H. postorchis*, both described by Rao, 1976). All *Hapalotrema* species were described from marine turtles except *H. polesianum*. This species was originally found in the freshwater turtle *Emys orbicularis* and published as *Spirhpalum polesianum* by Ejmont (1927) and later transferred to *Hapalotrema* by Byrd (1939). Only *H. mehrai* and *H. postorchis* have previously been recorded from *C. mydas*. *Hapalotrema loossi*, *H. synorchis*, and *H. mistroides* were all found in the log-

gerhead turtle (*Caretta caretta*) in Egypt, Florida, and an unknown locality, respectively. *Hapalotrema orientalis* was found in the hawksbill (*Eretmochelys squamosa*) on the island of Okinawa, Japan.

Two genera (*Hapalorhynchus* Stunkard, 1922, and *Coeuritrema* Mehra, 1933) from freshwater turtles have dorsal genital pores. However, the size of those pores is much smaller and less muscular than that described for *H. dorsopora*. This is the first report of a spirorchid trematode with separate dorsal (uterus) and ventral (cirrus) openings.

#### Acknowledgments

The authors thank Ms. Carol Lyon and Dr. Tom Douglass of California State University, Long Beach, for their help with the figures. We also thank Dr. J. Ralph Lichtenfels of the U.S. National Parasite Collection for loan of specimens and Barry Choy, National Marine Fisheries Service, Honolulu Laboratory, for his help during the field portion of this study. This study was partially funded by NMFS Contract #40 JJNF 9-0091. We gratefully acknowledge this support.

#### Literature Cited

- Byrd, E. E. 1939. Studies on the blood flukes of the family Spirorchiidae. Part II. Revision of the family and descriptions of new species. *Journal of the Tennessee Academy of Science* 14:116-161.
- Ejsmont, L. 1927. *Spirhapalum polesianum* n.g., n. sp. trematode du sang d'*Emys obicularis* L. *Annales de Parasitologie* 5:220-235.
- Glazebrook, J. S., R. S. F. Campbell, and D. Blair. 1989. Studies on cardiovascular fluke (Digenea: Spirorchiidae) infections in sea turtles from the Great Barrier Reef, Queensland, Australia. *Journal of Comparative Pathology* 101:231-248.
- Rao, S. L. 1976. On two new flukes (Trematoda, Spirorchidae) from the heart of *Chelone mydas* L. *Acta Parasitologica Polonica* 24:119-124.
- Skrjabin, K. I. 1964. Keys to the Trematodes of Animals and Man. University of Illinois Press, Urbana. 351 pp.
- Smith, J. W. 1972. The blood flukes (Digenea: Sanguinicolidae and Spirorchidae) of cold-blooded vertebrates and some comparison with schistosomes. *Helminthological Abstracts*, Series A 41 (2):161-204.
- Yamaguti, S. 1958. *Systema Helminthum*. Vol. 1. The digenetic trematodes of vertebrates. Pt. 1. Interscience Publishers, New York. 979 pp.

#### New Book Available

NEMATODE PARASITES OF VERTEBRATES: THEIR DEVELOPMENT AND TRANSMISSION, by R. C. Anderson, 1992, C. A. B. International, 600 pp. (hardback) ISBN 0 85198 799 0. Available from The University of Arizona Press, 1230 North Park Avenue, Tucson, Arizona 85719. US\$142.50 (Americas only).